2004 OMSI Bat Research Team
Summary of Findings

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Prepared by:

Marieka Ave, Nicholas Batter, Bryn Cram, Kristin Geurin, Maureen Kumar, Maureen McCaffrey, Tom Rodhouse, Ann Root, Jeff Turnoy, William Weatherford, and Madeline Wyse

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Executive Summary

The 2004 OMSI Bat Research Team assessed reuse and status of pallid bat (*Antrozous pallidus*) and Townsend's big-eared bat (*Corynorhinus townsendii*) maternity colonies and conducted bat species inventories in the John Day Fossil Beds National Monument, Craters of the Moon National Monument, and Hagerman Fossil Beds National Monument. The team was organized through a cooperative effort between the Oregon Museum of Science and Industry, the University of Idaho Department of Fish and Wildlife, and the National Park Service Upper Columbia Basin Network. The team consisted of 8 high school students from the Pacific Northwest, Texas, and Illinois, and 4 adult staff. This was the first formal collaboration between the museum and the Upper Columbia Basin Network, and significant contributions were made to the network's ongoing natural resources inventory and monitoring program.

The team built upon previous inventory and monitoring work conducted by the University of Idaho, the network, and other organizations. Primary methods employed by the team included the use of mist nets to capture bats, roost exit counts, and bat echolocation call recording and analysis. The bat call tools included both *Anabat* and *Sonobat* hardware and software systems. The team's primary objectives included the relocation and assessment of reuse and colony size for pallid bat and Townsend's big-eared bat maternity colonies previously identified in the John Day Fossil Beds and Craters of the Moon. The results of these assessments will be used by the network to develop monitoring strategies for these species. The bat team's objectives also included the inventory of bats in the Hagerman Fossil Beds and Craters of the Moon. No bat inventory had been conducted in Hagerman prior to the team's work. Significant bat work had been conducted in Craters of the Moon during the 1990's, but several species expected to occur there had not been well documented.

Rain hampered pallid bat roost monitoring efforts in the John Day Fossil Beds, but work conducted on one day and night in the Clarno Unit of the monument led to the discovery of two colonies in roosts near previously identified roosts. Estimates of colony sizes were 20 individuals. In Craters of the Moon, one Townsend's big-eared bat colony was found using the same cluster of lava tube caves as documented during the 1990's. Another lava tube nearby was reconfirmed as an important night roost. These roost monitoring activities demonstrated the feasibility of long-term monitoring of these important bat focal resources. Inventory efforts at Craters of the Moon confirmed the presence of two important species of bats, the fringed myotis (*Myotis thysanodes*) and the hoary bat (*Lasiurus cinereus*). At Hagerman Fossil Beds, no bats were captured but echolocation calls recorded there and near the monument were identified to 8 species of bats and an additional species, the hoary bat, was tentatively identified. As many as 14 species of bats may occur in all three of these monuments, representing an important and vulnerable component of biodiversity in the Upper Columbia Basin Network. More needs to be done with this group of mammals in the network, but preliminary management recommendations include the closure of roost caves to human entry.

I. Introduction

This report summarizes the findings of the 2004 Oregon Museum of Science and Industry (OMSI) Bat Research Team, a group of high school science students brought together to study bats in three national monuments in the interior Columbia Basin. The team was organized through a cooperative effort between the OMSI Science Camps Program, the University of Idaho Department of Fish and Wildlife, and the National Park Service Upper Columbia Basin Network (UCBN). OMSI has a long tradition of providing research opportunities for teenagers. The "tent and van" based research team approach has been used in the past to allow students to participate in ongoing research projects under direction by research professionals affiliated with Universities or other research organizations. The 2004 OMSI Bat Research Team is the first of its kind, as most past research teams have been focused on the rich paleontological and archaeological resources in and around OMSI's Hancock Field Station. This team also represents the first team to work formally with the UCBN. The team has succeeded in making a significant contribution to the network's inventory and monitoring program and it is now clear that the van-based high school research team model can and should be used in future network inventory and monitoring projects.

The 2004 Bat Research Team used a variety of methods to contribute to ongoing vertebrate inventories at Craters of the Moon National Monument and Preserve (CRMO) and Hagerman Fossil Beds National Monument (HAFO). The team also followed up on previous research conducted in the John Day Fossil Beds National Monument (JODA) and CRMO to monitor maternity colonies of pallid bats (*Antrozous pallidus*) and Townsend's big-eared bats (*Corynorhinus townsendii*) (see Keller and Saathoff 1995, Keller 1997, Rodhouse et al. forthcoming).

Over the past three years, the UCBN and the University of Idaho has been conducting vertebrate inventories in each of the 3 monuments as part of the National Park Service (NPS) Inventory and Monitoring Program (Oelrich et al. 2003, Rodhouse et al. 2004, Madison et al. forthcoming). As a group, bats represent a significant proportion of mammalian diversity in the network and many bat species found in the region have been identified as species of conservation concern by state, regional, and federal authorities. The developing UCBN long-term ecological monitoring program recognizes that bats may serve as important indicators of ecological health. The pallid bat and the Townsend's big-eared bat are of particular interest to the network because of their colonial roosting behavior and sensitivity to human disturbance (Vaughan and O'Shea 1976, Csuti et al. 2001).

To this end, the 2004 OMSI team had 3 primary objectives. The first was to relocate pallid bat maternity roosts in JODA. These roosts had originally been identified through telemetry work conducted in 2003 (Rodhouse et al. forthcoming). The team's objective was to determine the reuse and colony status of those roosts and to determine whether pallid bat maternity colonies could be efficiently monitored from year to year via exit counts. The second objective was to determine reuse and colony status of the Townsend's big-eared bat maternity colony in the North Caves Area of CRMO. This colony had originally been identified by Dr. Barry Keller and his graduate students from Idaho State University during the 1990's (Keller and Saathoff 1995, Keller 1997). As with the pallid bats in JODA, the UCBN is interested in monitoring this colony over time and the OMSI team's results will be used to develop a monitoring strategy. The third objective was to contribute to the ongoing mammal inventories at HAFO and CRMO. No previous bat inventory work had been conducted at HAFO and several species expected to occur in CRMO were not well documented.

The 2004 OMSI Bat Research Team was unique in that it relied on high school students who traveled from as far away at Texas and Illinois to participate. Students were trained in the various methods and life history topics required to study bats in the Pacific Northwest. Students quickly became proficient at most important research tasks, including the set-up and operation of mist nets, acoustic monitoring equipment, identification and measurement of captured bats, input of tabular and spatial data into Excel spreadsheets, and the management and analysis of digital bat call data. Students augmented field activities with library investigation and presentations on the life histories of each of the 12 bat species encountered during the program, as well as on other North American bats, and on larger issues of conservation biology. Students were also engaged by NPS interpretive and resource management staff at each of the monuments and participated in discussions on other topics including geology and paleontology. Traveling from JODA to HAFO provided a great opportunity to see the evolution of mammalian fossils (including those of bats!) from the Eocene up through the Pliocene epoch. This provided a fantastic backdrop to the student's study of current mammalian fauna. Students concluded the program by assembling the draft of this report, including maps generated with ArcView Geographic Information Systems (GIS), an important (and indispensible?) tool now used throughout the sciences wherever spatial data are used. A powerpoint slideshow of the program was assembled that captured both the research and the recreational activities enjoyed by the team. The students enjoyed one final night of bat research and exposure to professional scientists during an outing with USFS Wallowa-Whitman National Forest biologist Mark Penninger and his summer staff.

On a final note, great care was taken to eliminate the risk of rabies virus exposure to students. Prior to the program, students and their families were provided with rabies information from the U.S. Center for Disease Control and Bat Conservation International. In the Pacific Northwest, bat researchers are only at risk of rabies exposure if they receive a bite during handling of a captured bat. No students were bitten during the program. Pre-exposure vaccines are standard for professionals but were not required nor necessary for OMSI students. Two students were vaccinated prior to the program. During periods when bats were being captured and handled, one of three vaccinated staff facilitated students's investigation of the bat to determine species identification and to obtain morphological measurements. Great emphasis was placed on proper handling techniques and the use of protective gloves.

II. Study Area

John Day Fossil Beds

The John Day Fossil Beds National Monument is located in the John Day River valley of eastern Oregon. The monument was established in 1975 and congressional boundaries include a total of 14,014 acres. The monument consists of three separate units. The OMSI team worked in the two smaller units, Clarno and the Painted Hills. Both of these units are located in Wheeler County and contain 1969 and 3129 acres, respectively. OMSI's Hancock Field Station is located within the Clarno Unit. Ownership patterns adjacent to these units consist of a mosaic of Bureau of Land Management (BLM), tribal, and private lands and this ownership pattern is very influential in the biological diversity of the monument. JODA lies within a growing matrix of land dedicated to conservation of natural resources. The Confederated Tribes of Warm Springs have recently purchased over 15,000 acres of land adjacent to the Clarno Unit for long-term conservation of fish and wildlife. Several BLM natural research areas are also located near the monument.

The Clarno Unit, where the 2004 Bat Research Team focused its efforts, is located along Pine Creek. The Painted Hills Unit is located along Bridge Creek. Both of these creeks are important tributaries of the John Day River. Elevations range from approximately 1380 to 2500 feet. The extensive rain shadow cast by the Cascade Mountains and Ochoco mountains to the west dominates the climate of the monument. Winters are cool and dry and summers are hot and dry. Rainfall patterns are variable in the region but most falls in the early spring and late fall (Oregon Climate Service 2003). Although no weather stations are located in the Clarno Basin, nearby stations indicate that the basin probably averages less than 11 inches of rain per year (Oregon Climate Service 2003). Snowfall represents a small proportion of the winter precipitation and snowpack is ephemeral and rarely lasts more than a few days. Thirty-year January and July mean temperatures from Dayville, a town south east of the Sheep Rock Unit of the monument, are 36 and 71 degrees Fahrenheit, respectively (Oregon Climate Service 2003). Thirty-year mean January and July maximum and minimum temperatures are 45 and 90 degrees and 27 and 52 degrees, respectively (Oregon Climate Service 2003). It is important to note that winter and summer temperature extremes frequently drop below zero in the winter and above 100 degrees in the summer.

All three units of the monument lie within the Blue Mountain physiographic province and the John Day ecological province (Franklin and Dyrness 1988, Anderson et. al. 1998). These designations are useful in that they indicate some geological and ecological consistencies between the units. The area is rugged, with steeply dissected hills and cliffs (Anderson et. al. 1998). The soils of this region are largely volcanic clays and tuffs that have a profound influence on the vegetation. Higher portions of the monument are capped with ancient flood basalts and lithosols have formed in these areas. Much of the monument, especially in the Painted Hills Unit, contain bare and sparsely vegetated slopes of clays. Juniper-sagebrush steppe vegetation dominates most of the monument (Franklin and Dyrness 1988). In many areas, dense stands of juniper trees create a juniper woodland, with a much reduced shrub and grass component.

Craters of the Moon

Located on the eastern Snake River Plain of Idaho, Craters of the Moon National Monument and Preserve encompasses parts of Lincoln, Minidoka, Blaine, Power, and Butte counties. Originally established in 1924, the monument included 53,440 acres. In 2000 the monument was expanded by the addition of 661,000 acres of federal public lands to include the entire Great Rift Volcanic Rift Zone. In 2002, 415,000 acres of this addition were legislatively designated as a national preserve.

CRMO is cooperatively managed by the National Park Service (NPS) and the Bureau of Land Management (BLM) although each agency retains primary management authority in different areas. In general, the areas of younger exposed lava fields are managed by the NPS and the older sagebrush steppe dominated areas continue to be managed by the BLM. The BLM administered Monument is a unit of the National Landscape Conservation System, while the original Monument and Preserve are administered as units of the National Park System. The work of the OMSI team focused on the northern edge of the original monument, along the North Caves Area on the northern edge of the Great Rift lava flows and in Little Cottonwood Canyon, a drainage that dissects the southern edge of the Pioneer Mountains.

This area consists of a rugged landscape of volcanic lava flows and sagebrush steppe. During the last 15,000 years, molten basalt has periodically flowed from the Great Rift, a 65-mile long volcanic rift zone that lies within the monument. Lava fields encompass over 450,000 acres of the monument, and include 60 lava flows and 25 cinder cones. Sagebrush steppe makes up the approximately 300,000 remaining acres, much of which exists as islands within the lava flows, known as “kipukas”. CRMO extends south from the foothills of the Pioneer Mountains to the Snake River. The elevation rises from approximately 4280 ft. in the southern tip to 7729 ft. in the north. The climate is semi-arid, with hot and dry summers and cold and wet winters. Winter snows comprise most of the annual precipitation in the monument. Snow pack usually lasts most of the winter. The 30-year mean annual precipitation is 15 inches in the north (CRMO weather station data) and less than 10 inches in the south (Minidoka Dam, weather station data). The average July maximum temperature is 84 degrees fahrenheit and average January minimum temperature is 10 degrees degrees fahrenheit (CRMO weather station data). Surface temperatures on the lava flows can reach 170 degrees fahrenheit during summer heat and winter temperatures frequently remain below freezing for long periods.

CRMO supports several different vegetation types. The harsh and barren environment of the lava flows support an unusual variety of plant communities. The OMSI Bat Research Team focused in the North Caves Area which consists of sagebrush steppe vegetation that has become established on an older portion of the lava flows. Surface water is extremely scarce in the monument. Small ephemeral pools form during rainfall and subsurface ice lenses maintain small seeps and pools inside lava tubes and in the bottom of depressions in lava flows. The team also worked along Little Cottonwood Canyon, at the southern edge of the Pioneer Mountains. Along the canyon, small stands of aspen

(*Populus tremuloides*) and Douglas fir (*Pseudotsuga menzieseii*) grow and several semi-permanent streams flow off the mountains before disappearing beneath the lava flows. Lava Lake, a 4-acre lake, and a small hot springs complex exist along highway 20 near the northern boundary of the monument along the edge of the lava flow and provide important sources of water for wildlife, including bats. The OMSI team also visited these sites for bat inventory purposes.

Hagerman Fossil Beds

The Hagerman Fossil Beds National Monument is located in the Snake River Valley in southern Idaho. Paleontologists from the Smithsonian Institute in 1929 made the first excavations at the Hagerman Fossil Beds. The monument was established in 1988 and the congressional boundaries include a total of 4,281 acres. HAFO is located in Gooding County and Twin Falls County. The monument headquarters are located in the city of Hagerman. Ownership patterns adjacent to the monument consist of a mosaic of Bureau of Land Management (BLM) and private lands, and this ownership pattern is influential in the biological diversity of the monument. There are also several parks and wildlife refuges near the fossil beds, including Malad Gorge State Park, Billingsley Creek State Wildlife Management Area, Thousand Springs Nature Conservancy Reserve, and Hagerman Wildlife Management Area. HAFO is a management partner with several of these nearby parks and the OMSI team visited Malad Gorge State Park as part of its inventory effort.

The Hagerman Fossil Beds are located along the Snake River and includes seven miles of river shoreline. The Thousand Springs natural springs feature is on the east side of the river across from the monument and flows from the basalt cliffs into the river. Elevation of the monument ranges from 3508 ft at the top of the bluff and 2799 ft at the base of the river. The climate in the region is semi-arid, with cool and dry winters and hot and dry summers. Rainfall patterns are variable in the region but most falls in the early spring and late fall. 30-year mean annual precipitation available from a weather station 9 miles north of Hagerman in the town of Bliss is 9.5 inches (Western Regional Climate Center 2003). Snowfall represents a small proportion of the winter precipitation but snow pack is ephemeral and rarely lasts more than a few days. 30-year January and July mean temperatures from Hagerman are 35 and 67 degrees Fahrenheit, respectively (Western Regional Climate Service 2003). 30-year mean January and July minimum and maximum temperatures are 19 and 53 degrees Fahrenheit and 40 and 94 degrees Fahrenheit, respectively (Western Regional Climate Center 2003). It is important to note that winter and summer temperature extremes frequently drop below freezing in the winter and above 100 degrees in the summer.

The Hagerman Valley is located within the Snake River Plain region of the eastern Columbia Plateau. The topography is characterized by large flat plateaus deeply dissected by watercourses and large basalt canyons. The valley walls on the southside of the valley rise 600 feet above the Snake River. These bluffs consist of sediment layers deposited during pleistocene flooding. Large basalt canyons and rimrock are located along the north side of the valley, but none of these are actually on the monument. Sagebrush steppe vegetation dominates the monument, but grassland, forest, and riparian areas occur in the monument as well. Non-native vegetation has become established throughout the monument as well. Agricultural crops have replaced much of the natural vegetation on private lands adjacent to the monument.

III. Methods

For our research, we used three main methods: captures, acoustics, and exit counts, following standard protocol outlined in Kunz (1988) and the British Columbia Resources Inventory Committee Inventory Methods for Bats (1998). All locations were obtained with a hand-held Garmin Etrex GPS unit and are reported in the Universal Transverse Mercator (UTM) projection. The horizontal datum was NAD 27. JODA is in UTM zone 10, HAFO is in UTM zone 11, and CRMO is in UTM zone 12. Locations are accurate to within approximately 10 meters.

Captures

The 2004 OMSI Bat Research Team's main method for capturing bats were mist nets, although a handheld "H-net" (see Waldien and Hayes 1999) was used to capture night roosting myotis in JODA as a training activity.

The mist nets that the Bat Research Team used were standard four-tiered 2.6 meter tall nets that ranged in length from 2.6 meters to 18 meters. The mist nets were erected between two poles. The poles were hidden in vegetation when possible. Mist nets were placed along likely flight paths, such as open water, cave entrances, and openings in vegetation. The nets were set up before sunset but remained closed until sundown to avoid trapping birds. Opened nets were kept tight with a small amount of "bag" in each tier. When the nets were over water, care was taken to make sure the bottom tier was well above the water. Nets were closely monitored when open and bats were quickly removed upon capture.

At JODA, netting was conducted along Pine Creek adjacent to the monument on June 26 and at a stock pond in the monument on June 28, 2004. Three nets were set up at Pine Creek and two nets were placed at the stock pond. At CRMO, mist netting was conducted at Pond Cave on July 3 and along the two-track road in Little Cottonwood Canyon on July 4. A single net was placed at the entrance of Pond Cave and five nets were stretched along the road at Cottonwood Canyon. At HAFO, four nets were placed across an irrigation canal on the "Gisler property" portion of the monument on July 6.

All bats were handled following standard protocol outlined in Kunz (1988), the Ad Hoc Committee on Acceptable Field Methods in Mammalogy (1988), and procedures approved by the University of Idaho Institutional Animal Care and Use Committee.

Acoustics

The Research Team used two hardware/software systems for recording and analyzing bat calls: Anabat (Titley Electronics, Ballina, NSW, Ausralia; Corben Scientific, Rohnert Park, CA, USA) and Sonabat (DNDesign, Jacksonville, FL and Joe Szewczak; Pettersson Elektronik AB, Uppsala, Sweden). The Anabat system uses a "zero-crossings" method to collect, store, and display bat call data in frequency-time plots. Anabat was used to monitor bat activity and identify bats in two modes: active and passive. Active use of the

Anabat system involves the use of a laptop, which displays bat calls in "real time". Bats are often spotlighted during active recording in order to make helpful observations of bat size, shape, color, and flight behavior. Active use of Anabat also included the acquisition of voucher calls, these calls are recorded by hand-releasing a captured bat and recording it as it flies off. An alternative method of obtaining voucher calls involved the use of a "zip line" (Szewczak 2000) which allows for multiple call sequences to be recorded prior to releasing the bat. Passive Anabat recording involved the placement of an Anabat unit out at a location believed to have bats and set on automatic record mode. Files were stored on a compact flash card storage device. Once collected, we analyzed and identified bat calls to species or species groups (i.e. *Myotis spp.*) based on call frequency, slope, shape, and call intervals.

The Sonabat system uses a "time-expansion/full spectrum" method to collect, store, and display bat call data. This alternative method to Anabat provides time-frequency information as well as amplitude and harmonic characteristics. The Sonobat was always used in active mode during the OMSI team's research. Full spectrum bat calls were obtained with a Petterson (D240X) bat detector and downloaded to a field laptop to display and analyze calls. Library calls from both systems were used as reference aids in call analysis. Voucher calls obtained during our research are included in Appendix A of this report.

Exit Counts

Exit counting is a method to count the number of bats exiting a roost. During the exit count we used both natural light and a spotlight to illuminate the bats as they exited their day roosts. Our exit counts began at dusk and continued until there were no more bats leaving the roost. While doing the exit counts we counted the number of emergences and reemergences and subtracted the two numbers to obtain an estimate of bat colony size. We spent the evening of June 27, 2004 at the John Day Fossil Beds observing two different locations along the Palisades cliff complex. One location was at the site of two roosts found during telemetry work in 2003. The other location was in an area of suitable roost habitat but where no roosts had yet been found. Thunderstorm activity curtailed exit count efforts at the Painted Hills on June 29. We also spent the evening of July 2 observing three caves (Two-Step, Sandtrap, and Screaming Jaws of Death) in the North Caves Area of CRMO that had been previously documented as maternity colony sites for the Townsend's big-eared bat. Based on the results from July 2, an Anabat unit was placed at Screaming Jaws of Death on July 3 to obtain additional information on bat activity.

IV. Results

John Day Fossil Beds National Monument

At JODA, the 2004 Bat Research Team assessed the status of pallid bat maternity roosts identified in 2003 (see Rodhouse et al. forthcoming). The roosts were located in long, narrow, diagonal crevasses in the face of the Palisades cliff complex, located in the Clarno Unit. We surveyed several of these roost sites for signs of current use. Though we scanned the area visually during daylight hours and used bat detectors to pick up any preflight bat chatter, we were unable to confirm reuse by pallid bats.

However, observations made of the general roost area at night led to the discovery of two new pallid bat maternity roosts. The first was located in the same south facing cliff face as two 2003 roosts (see figure 1) and the second was located farther to the east in an area where no previous pallid bat roosts had been documented (see figure 1). The aspect of the cliff face on which the first new roost was located was 170 degrees and the aspect of the second was 137°. Roost heights were estimated to be 20 meters. However, we were unable to see the actual roost opening and the aspect and height of the actual roosts is unknown.

Exit counts where taken at each roost. Pallid bats were identified in flight by their comparatively large size and their distinctive audible social calls. Approximately 15 bats were identified at each site, although due to the obscurity of the alcoves and the fact that the exit counts did not begin until after the bats began to leave their roosts, it was estimated that 30-40% of the total pallid bats present were not counted, bringing the total estimates closer to 20 bats. An attempt to assess pallid bat roost reuse on June 29th in the Painted Hills Unit was unsuccessful due to heavy thunderstorms.

In addition to our efforts monitoring pallid bats on the Palisades, we used mist nets and an "H-net" to capture and identify bats at three separate locations in the Clarno area. Our first location was at the Potter Place, along Pine Creek adjacent to the Palisades (see figure 1). On June 26th, one 6 meter net and two 2.6 meter nets were opened for 2 hours, resulting in the capture of one adult male western pipistrelle (*Pipistrellus hesperus*) and one adult male big brown bat (*Eptesicus fuscus*) (see table 1).

On June 28th we mist netted the 2nd Stock Pond, located in Hancock Canyon above the Hancock Field Station. We spanned the pond with one 12 meter and one 18 meter net in a V-formation. Nets were left open for approximately 2 hours, and 13 bats were captured representing 5 species (see table 1).

As a training exercise, we trapped night roosting bats at an abandoned schoolhouse along the John Day River on June 27th using an "H-net". One adult female little brown myotis *(Myotis lucifugus)* and three adult female Yuma myotis *(Myotis yumanensis)* were captured.

Craters of the Moon National Monument

At Craters of the Moon National Monument, the research team assessed the status of Townsend's big-eared bat maternity colonies in the North Caves Area. On July 2nd, Two-Step, Sandtrap, and Screaming Jaws of Death lava tube caves were visited and exit counts were made at Two-Step and Sandtrap caves (see figure 2). Several Townsend's big-eared bats were observed "light testing" the opening of Screaming Jaws of Death prior to sunset. No Townsend's big-eared bats were encountered at Two-Step and Sandtrap caves. One unidentified bat was observed exiting the Two-Step cave and several unidentified myotis were observed exiting Sandtrap Cave. On July 3rd, passive Anabat recording at Screaming Jaws of Death indicated significant use of the cave by Townsend's big-eared bats, as well as several unidentified myotis species. Voucher recordings from this cave are shown in Appendix A.

On July 2nd, Anabat recording indicated significant use of Pond Cave as a night roost by several species of myotis and Townsend's big-eared bats. On July 3rd, The cave was mist netted with one 2.6 meter net across the entrance. A total of 40 bats were captured representing 3 species (see table 3). All bats were captured attempting to enter the cave. No day roosting bats were encountered there.

On July 4th, the team mist netted along the road traversing Little Cottonwood Canyon. This was done in an attempt to follow up on the inventory work done by Barry Keller. Keller netted a pond along the creek on several occasions during the 1990's (see Keller and Saathoff 1996), but the beaver dam holding the pond has been washed out and the pond can no longer be effectively netted. In lieu of this, we placed 5 mist nets across the road under the aspen canopy (see figure 2). Thirty-two bats were captured, representing 4 species. Particularly noteworthy was the capture of one male fringed myotis (*Myotis thysanodes*) (see table 3). During this net session, Anabat and Sonobat recordings were made of captured bats and free-flying bats. One recording was made of a passing hoary bat (*Lasiurus cinereus*). Voucher calls of the hoary bat and the captured fringed myotis are presented in appendix A.

An Anabat unit was also placed at Lava Lake, on the northern boundary of the monument on July 4th. Many bat passes were recorded there from at least 2 species of unidentified myotis, long-eared myotis (*Myotis evotis*), and big brown bats. At least one pass of a hoary bat was recorded as well (see Appendix A).

Hagerman Fossil Beds National Monument

At Hagerman Fossil Beds National Monument, the team had difficulty finding suitable mist net locations. The presence of the Snake River and the topography of the monument made for difficult netting situations. On July 5, an Anabat unit was placed along the "Gisler Property" irrigation canal below the monument's paleontology lab (see figure 3). Although bat activity was relatively slow, several species of bats were recorded there. Follow-up mist net efforts made there on July 6th proved unsuccessful. However, a total of 8 species were confirmed in the Hagerman Valley through bat call recordings and an additional species, the hoary bat, was tentatively identified from a call fragment recorded at the "Gisler Property". Table 3 shows the species confirmed in the Hagerman Valley through recordings. Voucher calls are presented in Appendix A. Effort was also made to document spotted bats (*Euderma maculatum*) in Malad Gorge, northwest of the monument. On July 5 and 7, 2004, the team climbed up on to different portions of the canyon rim to record bats and listen for audible spotted bat calls. No spotted bats were detected but several other species of bats were confirmed through acoustic methods, including the Townsend's big-eared bat, pallid bat, and the western pipistrelle (see table 5). Acoustic monitoring was also conducted at an unnamed stock pond on private land adjacent to the monument and several species were recorded there (see figure 3 and tables 5 and 6).

V. Discussion

John Day Fossil Bed National Monument

Although the efforts to assess pallid bat roost reuse were hampered by foul weather, the results of the work conducted at the Palisades on June 27th suggest that maternity colonies can be monitored over time with minimal equipment and training. The counts made at the two new roosts provided estimates (approximately 20 bats) that are consistent with exit counts made in 2003. The audible social calls made by this species during roost exits and their large size make them relatively easy to count. This species remains one of conservation concern by the Oregon Department of Fish and Wildlife and the Oregon Heritage Program (Csuti et al. 2001, Eric Scheuering, Oregon Heritage Program, personal cmmunication). The NPS Upper Columbia Basin Network is currently developing a monitoring plan that will address pallid bats in the monument. Based on the team's experience, it now appears feasible to plan annual or biannual visits to the Palisades and the other areas with documented pallid bat roosts to perform exit counts and to document new roosts.

Craters of the Moon National Monument

Several important discoveries were made by the team at CRMO. In the North Caves Area, the Screaming Jaws of Death Cave was determined to be the present location of a Townsend's big-eared bat maternity colony. Although no bats were captured there, the large number of Anabat calls recorded suggest this to be the case. Also, several Townsend's big-eared bats were observed "light testing" the entrance during placement of the Anabat unit. Summer concentrations of male Townsend's big-eared bats are rare and confirmation of past use of this cave by females by Keller and Saathoff (1995) support our conclusion. Our experiences at Screaming Jaws of Death, Sandtrap, and Two-Step caves are consistent with Keller's during the 1990's. These three caves, and possibly Antelope Cave as well, appear to be alternate roosts sites for one colony of Townsend's big-eared bats. During a brief socuting visit to Two-Step Cave in June 2003, one of us (T. Rodhouse) observed several Townsend's big-eared bats "light testing" the opening, suggesting the colony was using that cave at that time. It is not clear exactly why the colony switches roosts, but this rooost switching behavior has been noted in the pallid bats of JODA and many other species as well (see Lewis 1995). These caves remain an important resource area for the Townsend's big-eared bats as well as several species of Myotis, and conservation measures, including the exclusion of human entry during summer months, should be continued. The Townsend's big-eared bat is listed as a species of concern both by the state of Idaho and the U.S. Fish and Wildlife Service. As in the case of pallid bats at JODA, the NPS Upper Columbia Basin Network will address these cave roosts in the developing monitoring plan.

The discovery of the fringed myotis and the hoary bat foraging along Little Cottonwood Canyon and Lava Lake was also important. Neither of these species have been well documented in the monument prior to our expedition (Mike Munts, NPS, personal communication). Both are relatively rare species that rely on forested habitats. The fringed myotis is listed as a species of concern by the state of Idaho and the U.S. Fish and Wildlife Service.

Hagerman Fossil Beds National Monument

Despite the difficulty trapping bats on the monument, our efforts recording bats led to the confirmation of at least 8 species of bats. It is likely that several other species also occur in the valley. We were surprised by the relative lack of bat activity on the Gisler Property. The monument itself does not possess much in the way of important bat roosting habitat. The small band of rimrock west of the horse quarry may provide roosting opportunities for the western small-footed myotis (*Myotis ciliolabrum*) and other non-colonial rock roosting species. The buildings of the Gisler Property may provide night roosting opportunities at times, although we did not find evidence of this. Malad Gorge is a likely roosting area for a number of important species, including the Townsend's big-eared bat and the pallid bat, and the bats that roost there probably fan out to forage over the Hagerman Valley, including the Snake River and portions of the monument. We remain confident that the spotted bat probably occurs in Malad Gorge and also in the Hagerman Valley and up into the Snake River Canyon at Twin Falls. To the extent that we understand the habitat requirements for this rare species, the combination of the large cliffs, agricultural fields, and the open water of the river provides excellent habitat for this species (Luce in press, Rodhouse et al. in press). We were interested in the presence of the western pipistrelle at Malad Gorge. While this species is currently not one considered at risk, the Hagerman Valley is probably near the northen limit of its range in south central Idaho (Digital Atlas of Idaho 2003). Future surveys would help provide a more detailed understanding of both species presence and the pattern of bat use in the valley. Several other species not confirmed during our survey that probably occur, at least periodically, in the valley include the California myotis (*Myotis californicus*) and the silver-haired bat (*Lasionycteris noctivagans*).

Acknowledgments

We wish to thank the Oregon Museum of Science and Industry Science Camps Program, the NPS Upper Columbia Basin Network, and the University of Idaho Department of Fish and Wildlife for providing support for this project. Funding was provided through a cooperative agreement (no. CA9000-95-018 subagreement no. 20) between the University of Idaho and the NPS Upper Columbia Basin Network and also by the families of the research team members. We are particularly thankful to the families who supported their children's participation. We thank the staff of the John Day Fossil Beds, Craters of the Moon, and Hagerman Fossil Beds for taking time out of their schedule to spend with us.

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Tables

Table 1. The capture results from two mist net sessions in the John Day Fossil Beds National Monument.

Location	Cap. #	Time	Species[a]	Age	Sex	Repro.	Forearm
Potter Place	1	2150	PIHE	A	M	NR	29.0
Potter Place	2	2231	EPFU	A	M	NR	46.1
2nd Stock Pond	1	2130	PIHE	A	M	NR	28.7
2nd Stock Pond	2	2140	PIHE	A	M	NR	29.3
2nd Stock Pond	3	2142	MYCI	A	M	NR	31.1
2nd Stock Pond	4	2142	MYCI	A	F	PG	32.1
2nd Stock Pond	5	2142	MYCI	A	M	NR	32.6
2nd Stock Pond	6	2149	MYCI	A	M	NR	32.0
2nd Stock Pond	7	2200	MYCI	A	F	PG	31.6
2nd Stock Pond	8	2150	PIHE	A	M	NR	28.6
2nd Stock Pond	9	2215	LANO	A	M	NR	40.0
2nd Stock Pond	10	2235	ANPA	A	F	LAC	53.3
2nd Stock Pond	11	2253	EPFU	A	M	NR	46.2
2nd Stock Pond	12	2310	EPFU	A	M	NR	48.4
2nd Stock Pond	13	2334	EPFU	A	M	NR	46.1

[a] PIHE = *Pipistrellus hesperus* **EPFU= *Eptesicus fuscus***
MYCI= *Myotis ciliolabrum* **LANO= *Lasionycteris noctivagans***
ANPA= *Antrozous pallidus*

Table 2. The location of the net locations surveyed in the John Day Fossil Beds. The horizontal datum for UTM locations is NAD 27, accuracy is approximately 10 meters.

Date	Station Name	Sunset	Nets Open	Nets Closed	UTM X	UTM Y	Elevation
26-Jun-04	Potter Place	2030	2107	2300	703965	4976077	436
28-Jun-04	2nd Stock Pond	2030	2115	2335	703743	4977694	513

Table 3. The capture results from two mist net sessions in Craters of the Moon National Monument.

Site Name	Cap. #	Time	Species[a]	Age	Sex	Repro.	Forearm
Pond Cave	01	2140	myvo	A	F	P	40.3
Pond Cave	02	2140	myvo	A	F	P	39.0
Pond Cave	03	2140	myvo	A	M	NR	41.5
Pond Cave	04	2150	myvo	A	M	NR	40.7
Pond Cave	05	2153	myvo	A	M	NR	36.2
Pond Cave	06	2153	myvo	A	M	NR	35.3
Pond Cave	07	2154	myev	A	F	P	37.6
Pond Cave	08	2150	myvo	A	M	NR	39.4
Pond Cave	09	2153	myvo	A	M	NR	39.0
Pond Cave	11	2155	myvo				39.7
Pond Cave	12	2200	myev	A	M	NR	41.2
Pond Cave	13	2200	myvo	A	M	NR	41.1
Pond Cave	14	2202	myev	A	M	NR	36.6
Pond Cave	15	2204	myvo	A	M	NR	40.7
Pond Cave	16	2205	myev	A	M	NR	37.7
Pond Cave	17	2206	myev	A	F	P	38.4
Pond Cave	18	2208	myev	A	M	NR	38.3
Pond Cave	19	2215	myvo	A	F	P	40.0
Pond Cave	20	2216	myvo	A	F	P	38.8
Pond Cave	21	2223	myev	A	M	NR	36.7
Pond Cave	22	2224	myev	A	M	NR	35.7
Pond Cave	23	2230	coto	A	M	NR	43.4
Pond Cave	24	2235	myev	A	M	NR	41.2
Pond Cave	25	2235	myvo	A	M	NR	38.2
Pond Cave	26	2244	myvo	A	M	NR	38.9
Pond Cave	27	2249	myvo	A	M	NR	38.9
Pond Cave	28	2250	myev	A			
Pond Cave	29	2255	myvo	A	M	NR	40.2
Pond Cave	30	2257	myvo	A	F	P	41.3
Pond Cave	31	2300	myvo	A	M	NR	40.3
Pond Cave	32	2306	myvo	A	M	NR	40.4
Pond Cave	33	2307	coto	A	M	NR	41.6
Pond Cave	34	2308	myev	A	F	PG	38.4
Pond Cave	35	2312	myev	A	M	NR	36.0
Pond Cave	36	2314	myve	A	M	NR	37.7
Pond Cave	37	2322	myvo	A	M	NR	36.6
Pond Cave	38	2325	myvo	A	M	NR	39.4
Pond Cave	39	2325	myvo	A	F	PG	36.6
Pond Cave	40	2331	myvo	A	M	NR	40.1
Little Cottonwood Cr.	1	2204	myci	A	F	LAC	32.1
Little Cottonwood Cr.	2	2205	myci	A	M	NR	31.6
Little Cottonwood Cr.	3	2208	myvo	A	F	P	39.2
Little Cottonwood Cr.	4	2217	myev	A	M	NR	36.6
Little Cottonwood Cr.	5	2224	myci	A	M	NR	32.8
Little Cottonwood Cr.	6	2225	myev	A	M	NR	38.7

Site Name	Cap. #	Time	Species[a]	Age	Sex	Repro.	Forearm
Little Cottonwood Cr.	7	2228	myvo	A	M	NR	38.3
Little Cottonwood Cr.	8	2233	myev	A	M	NR	36.6
Little Cottonwood Cr.	9	2239	myev	A	F	P	38.2
Little Cottonwood Cr.	10	2240	myvo	A	M	NR	41.5
Little Cottonwood Cr.	11	2246	myci	A	M	NR	32.2
Little Cottonwood Cr.	12	2248	myci	A	F	LAC	31.6
Little Cottonwood Cr.	13	2250	myci	A	M	NR	32.0
Little Cottonwood Cr.	14	2254	myvo	A	M	NR	39.0
Little Cottonwood Cr.	15	2255	myci	A	M	NR	32.0
Little Cottonwood Cr.	16	2255	myci	A	F	P	32.2
Little Cottonwood Cr.	17	2255	myvo	A	F	P	38.7
Little Cottonwood Cr.	18	2255	myci	A	F	P	32.2
Little Cottonwood Cr.	20	2302	myvo	A	M	NR	40.1
Little Cottonwood Cr.	21	2302	myci	A	M	NR	33.5
Little Cottonwood Cr.	22	2313	myci	A	F	P	32.8
Little Cottonwood Cr.	23	2313	myci	A	M	NR	34.1
Little Cottonwood Cr.	25	2312	myci	A	F	PG	31.7
Little Cottonwood Cr.	26	2313	myth	A	M	NR	42.6
Little Cottonwood Cr.	27	2320	myci	A			
Little Cottonwood Cr.	28	2333	myci	A	F	P	33.6
Little Cottonwood Cr.	29	2343	myci	A	F	P	34.1
Little Cottonwood Cr.	30	2350	myci	A	F	P	32.1
Little Cottonwood Cr.	31	2350	myev	A	F	P	
Little Cottonwood Cr.	32	2355	myci	A			

[a] **MYVO= *Myotis volans*** **MYEV= *Myotis evotis***
COTO= *Corynorhinus townsendii* **MYCI= *Myotis ciliolabrum***
MYTH= *Myotis thysanodes*

Table 4. The location of the mist net locations surveyed in Craters of the Moon National Monument. Note that the location of Pond Cave is deliberately withheld for resource protection purposes. Contact Craters of the Moon National Monument for more information. The horizontal datum for locations is NAD 27, accuracy is estimated to be 10 meters.

Date	Station Name	Sunset	Nets Open	Nets Closed	UTM X	UTM Y	Elevation
3-Jul-04	Pond Cave	2018	2130	2332	-	-	1818
4-Jul-04	Little Cottonwood Cyn.	2018	2130	2400	290711	4817566	1888

Table 5. The bat species documented using active and passive acoustic monitoring techniques in and around the Hagerman Fossil Beds National Monument.

Date	**Location**	**Time**	**Species[a]**	**Call File**	**Recording Type**
06-Jul-04	Gisler Property	0356	MYYU	E7060356.51#	Passive Anabat
05-Jul-04	Gisler Property	2344	LACI ?	E7052344.12#	Passive Anabat
05-Jul-04	Gisler Property	2207	MYCI	E7052207.46#	Passive Anabat
06-Jul-04	Gisler Property	2311	ANPA	E7062311.00#	Active Anabat
06-Jul-04	Stock Pond, Hagerman	2315	EPFU	E7062315.52#	Active Anabat
05-Jul-04	Malad Gorge	2222	PIHE	07Jul04-2222,27.wav	Sonobat
07-Jul-04	Malad Gorge	2328	COTO	E7082328.25#	Active Anabat
07-Jul-04	Malad Gorge	2232	MYEV	E7082232.39#	Active Anabat
07-Jul-04	Malad Gorge	2239	MYLU	E7072239.30#	Active Anabat

[a] MYYU= *Myotis yumanensis*
LACI ?= *Lasiurus cinereus* (tentative ID)
MYCI= *Myotis ciliolabrum*
ANPA= *Antrozous pallidus*
EPFU= *Eptesicus fuscus*
PIHE= *Pipistrellus hesperus*
COTO= *Corynorhinus townsendii*
MYEV= *Myotis evotis*
MYLU= *Myotis lucifugus*

Figures

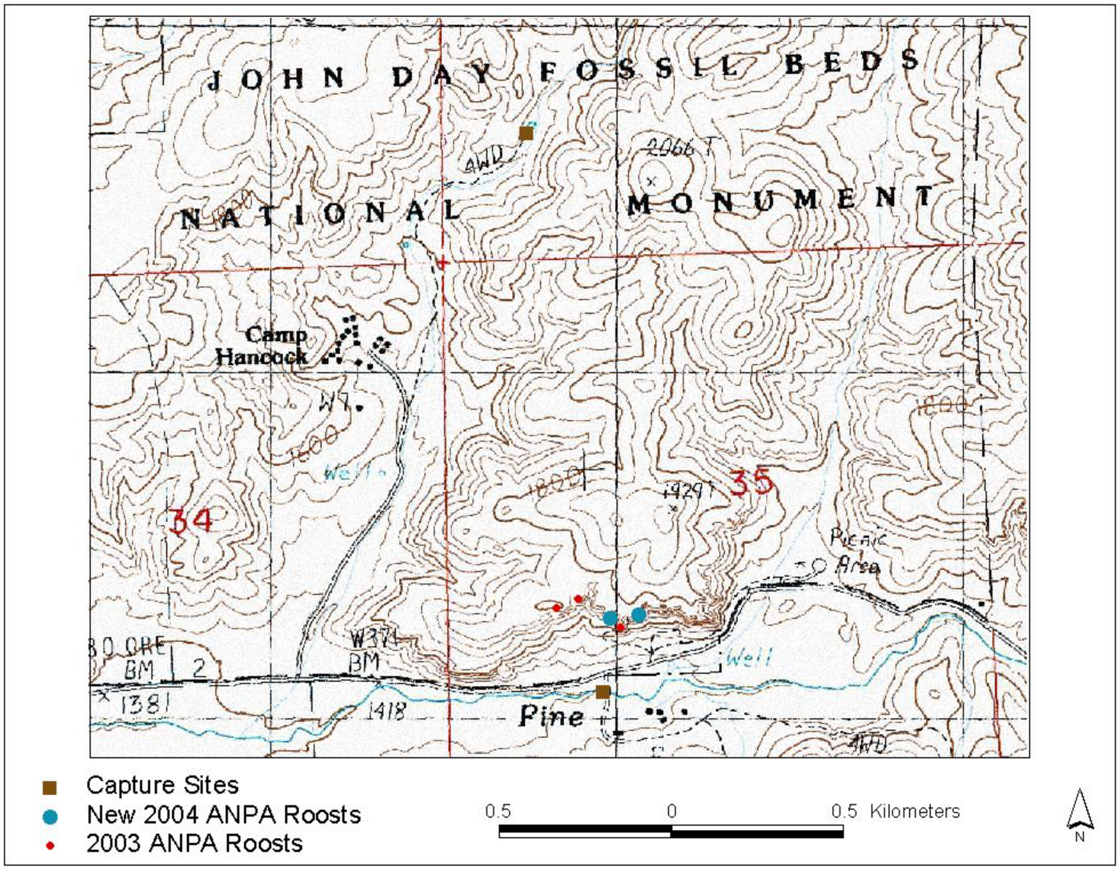

Figure 1. The map of the Clarno Unit of the John Day Fossil Beds National Monument, and the 2004 OMSI Bat Team capture locations and pallid bat (*Antrozous pallidus*) roost locations.

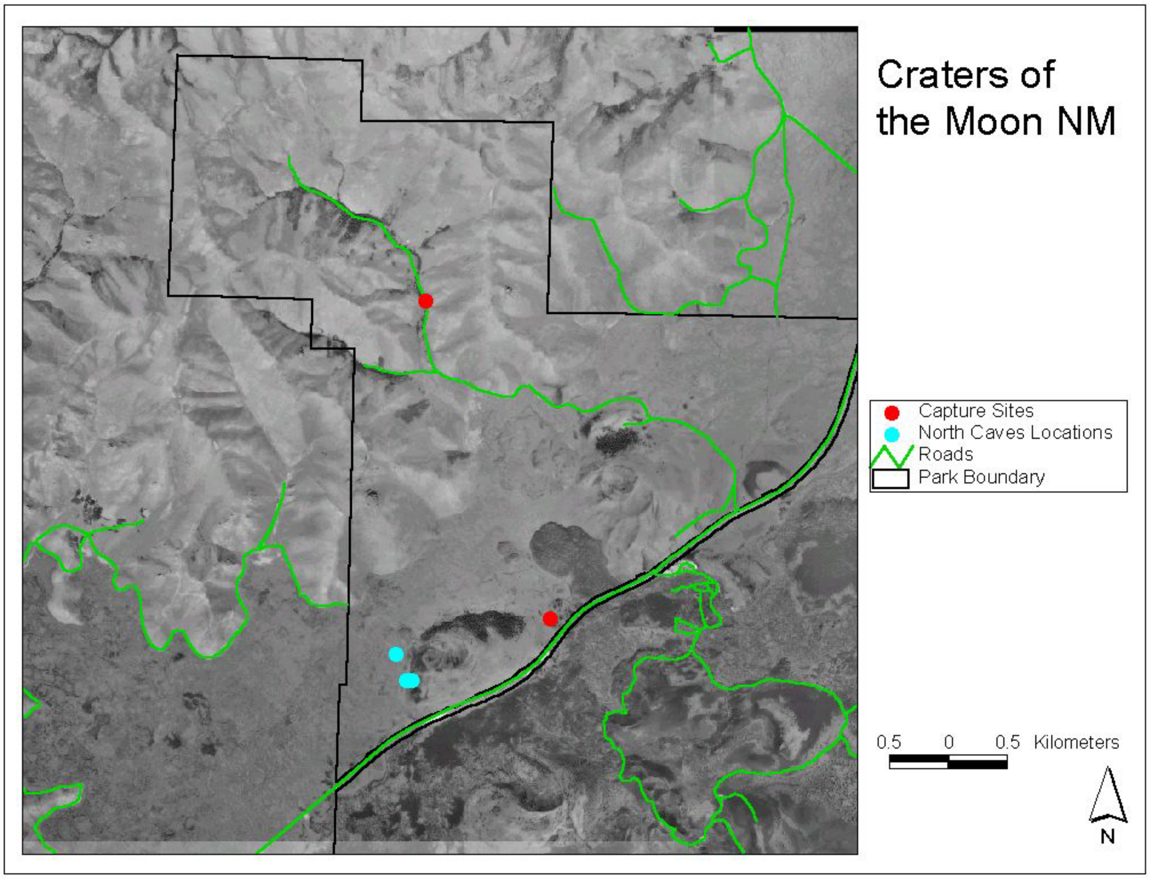

Figure 2. The map of the northern portion of Craters of the Moon National Monument, 2004 Bat Team mist net locations, and Townsend's big-eared bat (*Corynorhinus townsendii*) maternity colony cave locations.

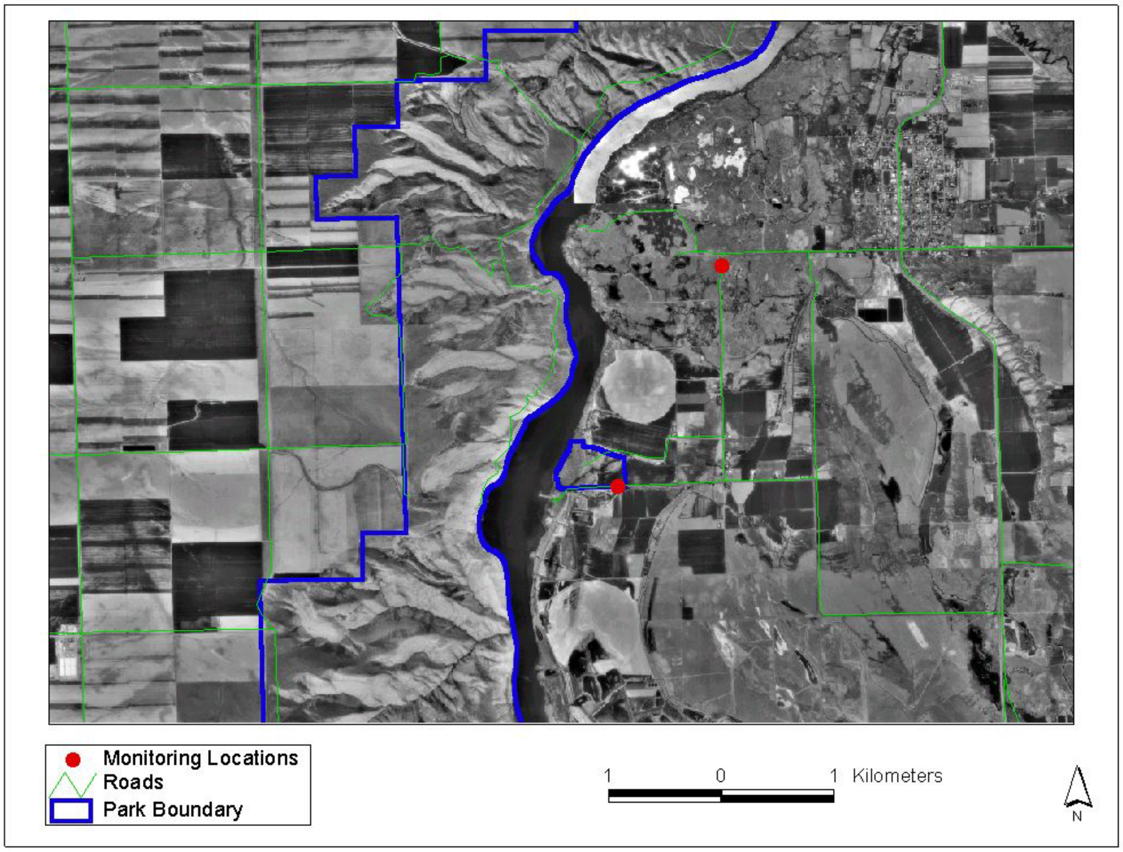

Figure 3. The map of the Hagerman Fossil Beds and monitoring locations visited by the 2004 OMSI Bat Research Team. Note that the monitoring locations at Malad Gorge State Park are not shown on this map.

Appendix A

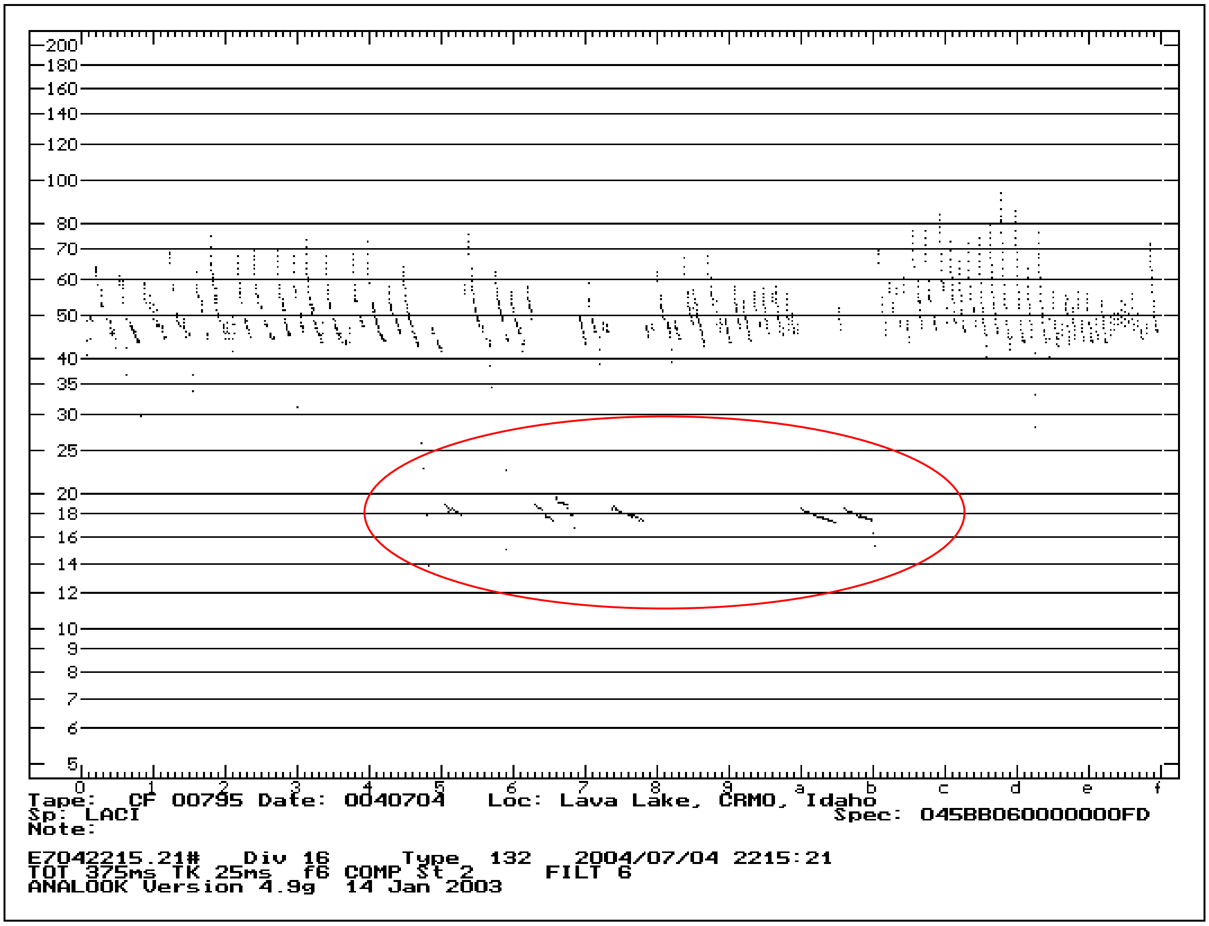

Figure A-1. A hoary bat (*Lasiurus cinereus*) call fragment recorded at Lava Lake on July 4, 2004. Note the unidentified “40K” myotis call also in the file.

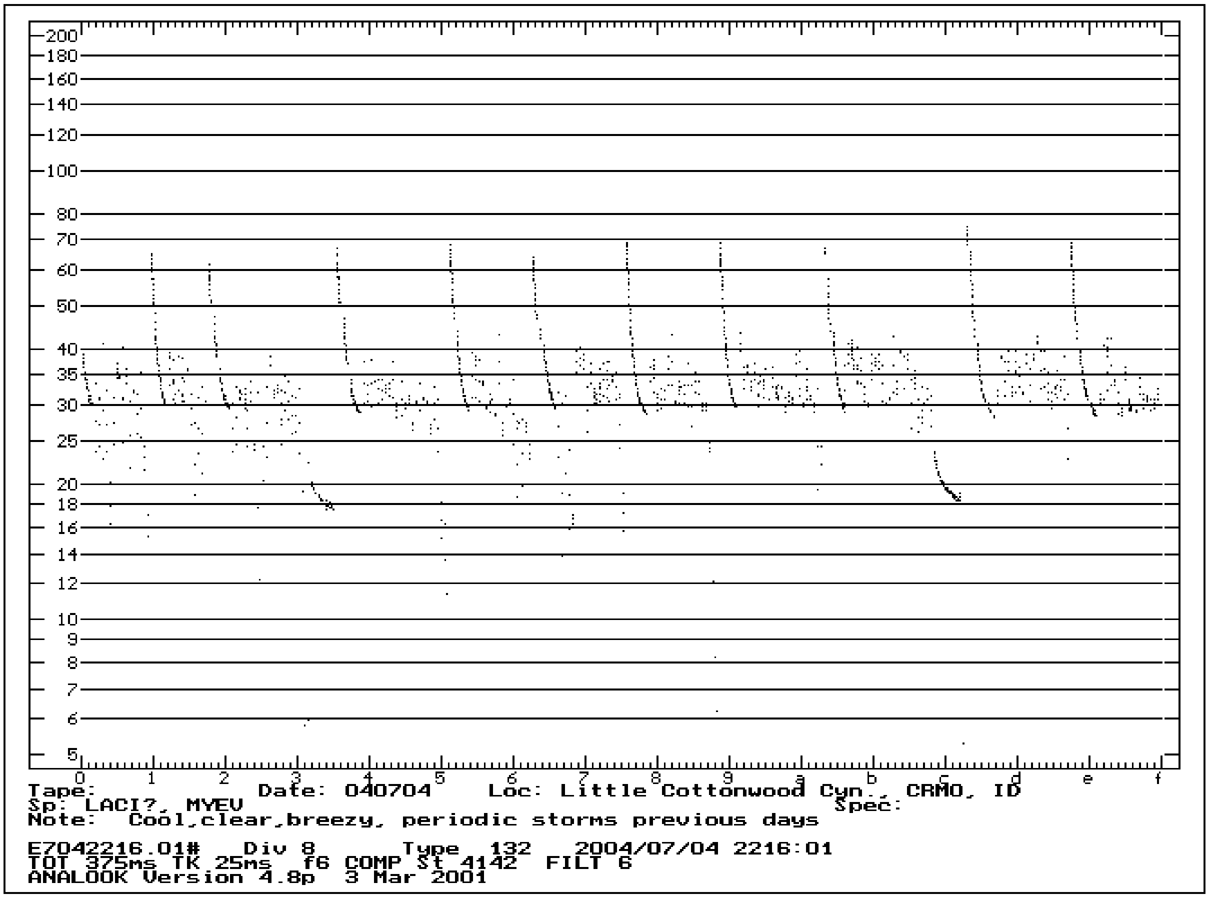

Figure A-2. A hoary bat call fragment from Little Cottonwood Canyon recorded on July 4, 2004. Only 2 calls are visible in this file, but the low frequency (18 Khz) and the relatively "flat" call shape indicate these were made by a passing hoary bat. Note the long-eared myotis (*Myotis evotis*) call sequence terminating at 30 Khz.

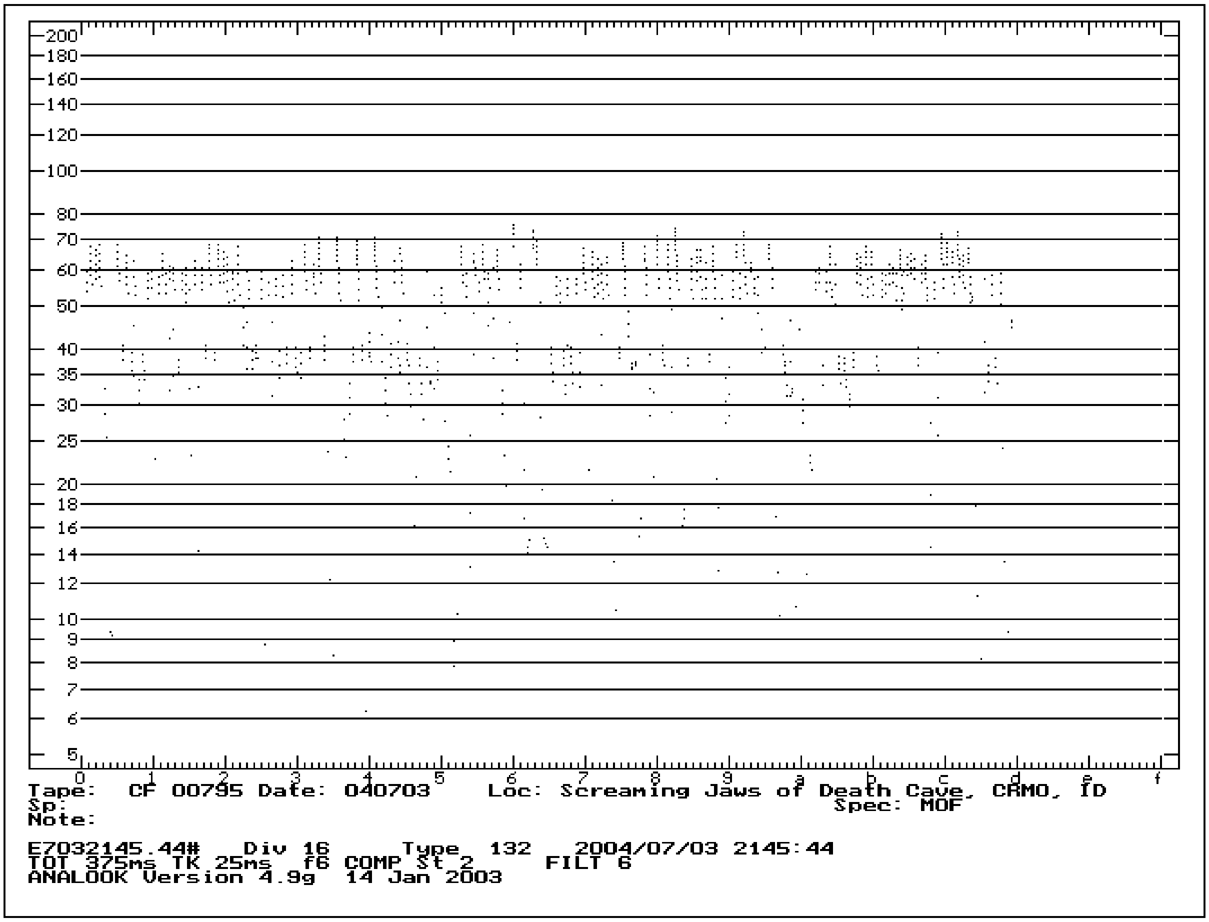

Figure A-3. A Townsend's big-eared bat (*Corynorhinus townsendii*) call recorded at Screaming Jaws of Death Cave on July 3, 2004.

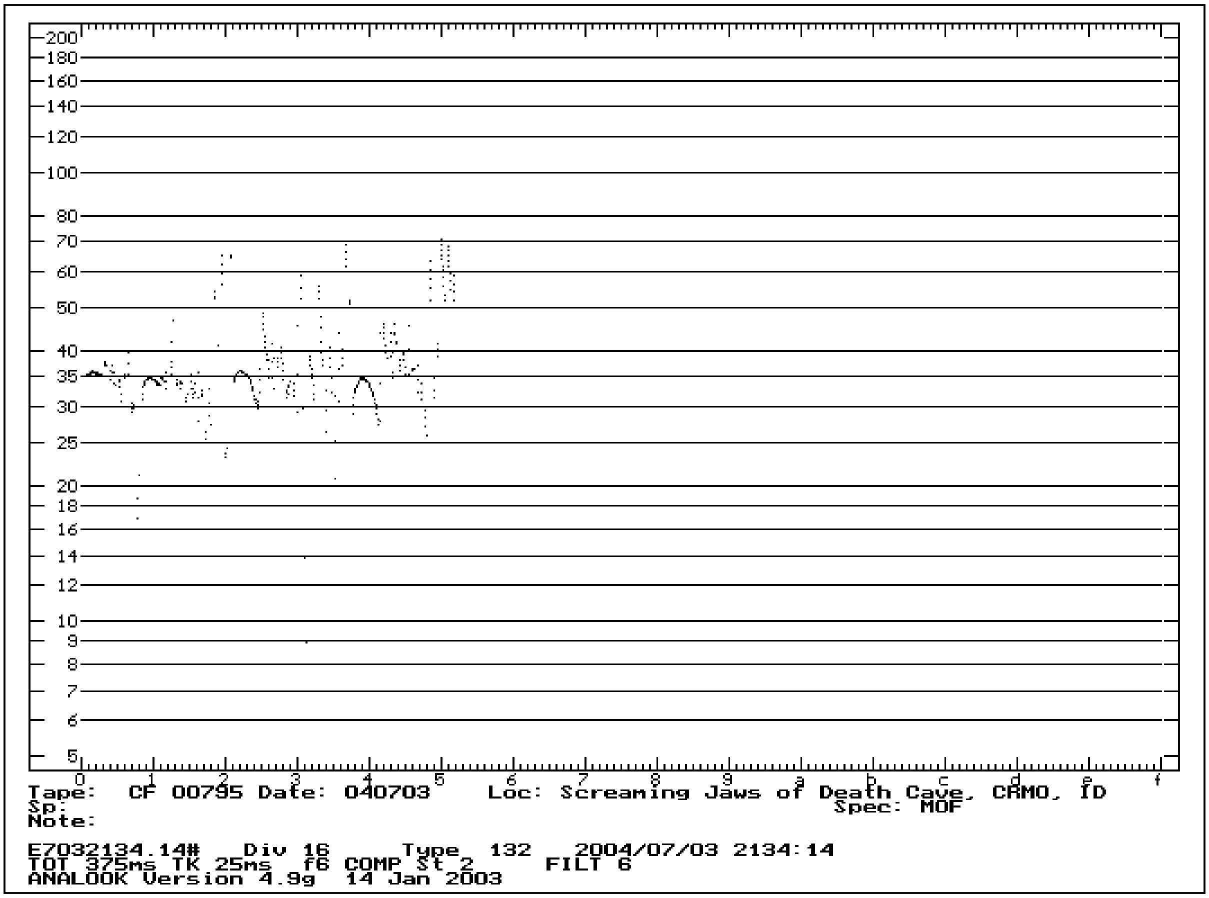

Figure A-4. A Townsend's big-eared bat call recorded at Screaming Jaws of Death Cave on July 3, 2004. Note the social call sequences in this file.

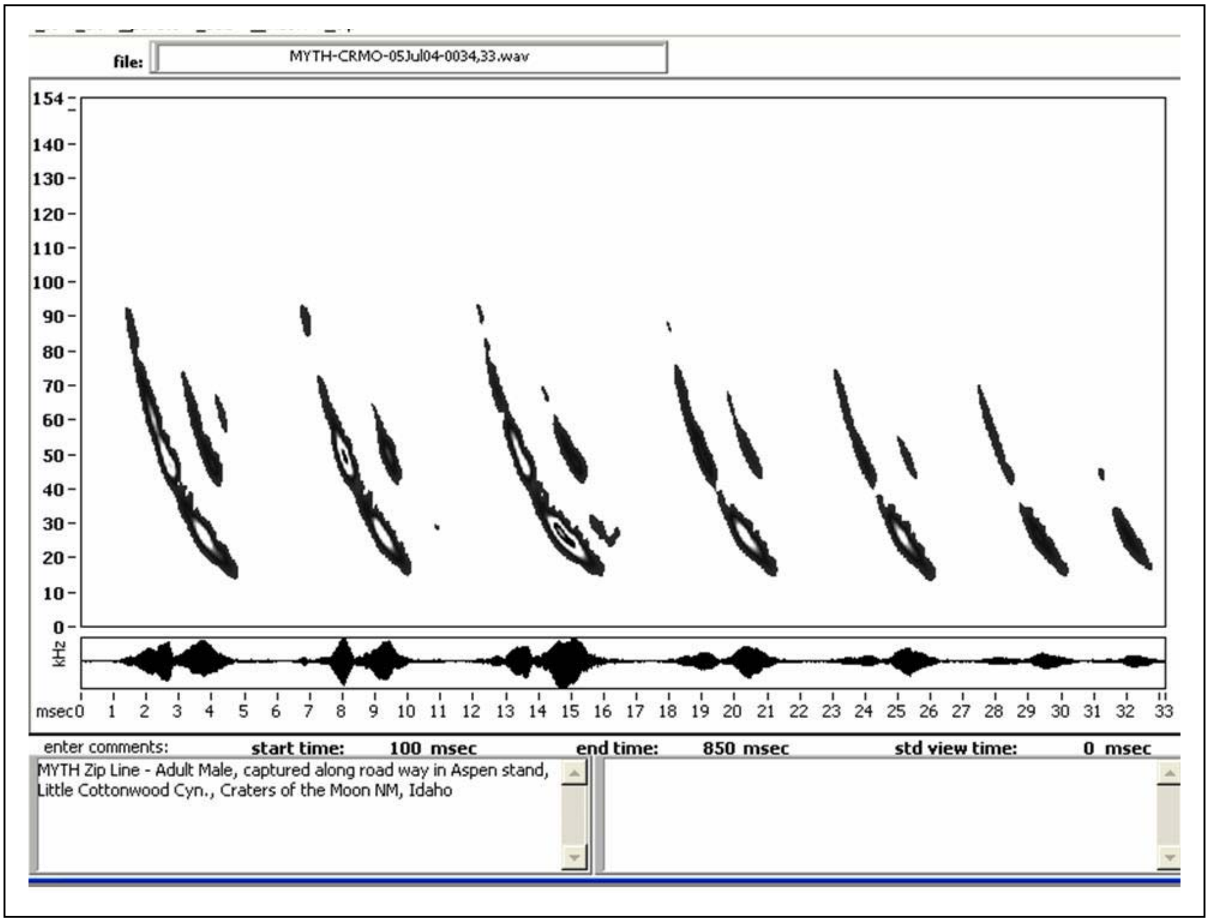

Figure A-5. A voucher recording made with Sonobat of an adult male fringed myotis captured along Little Cottonwood Creek. This recording was obtained using a “zip-line”.

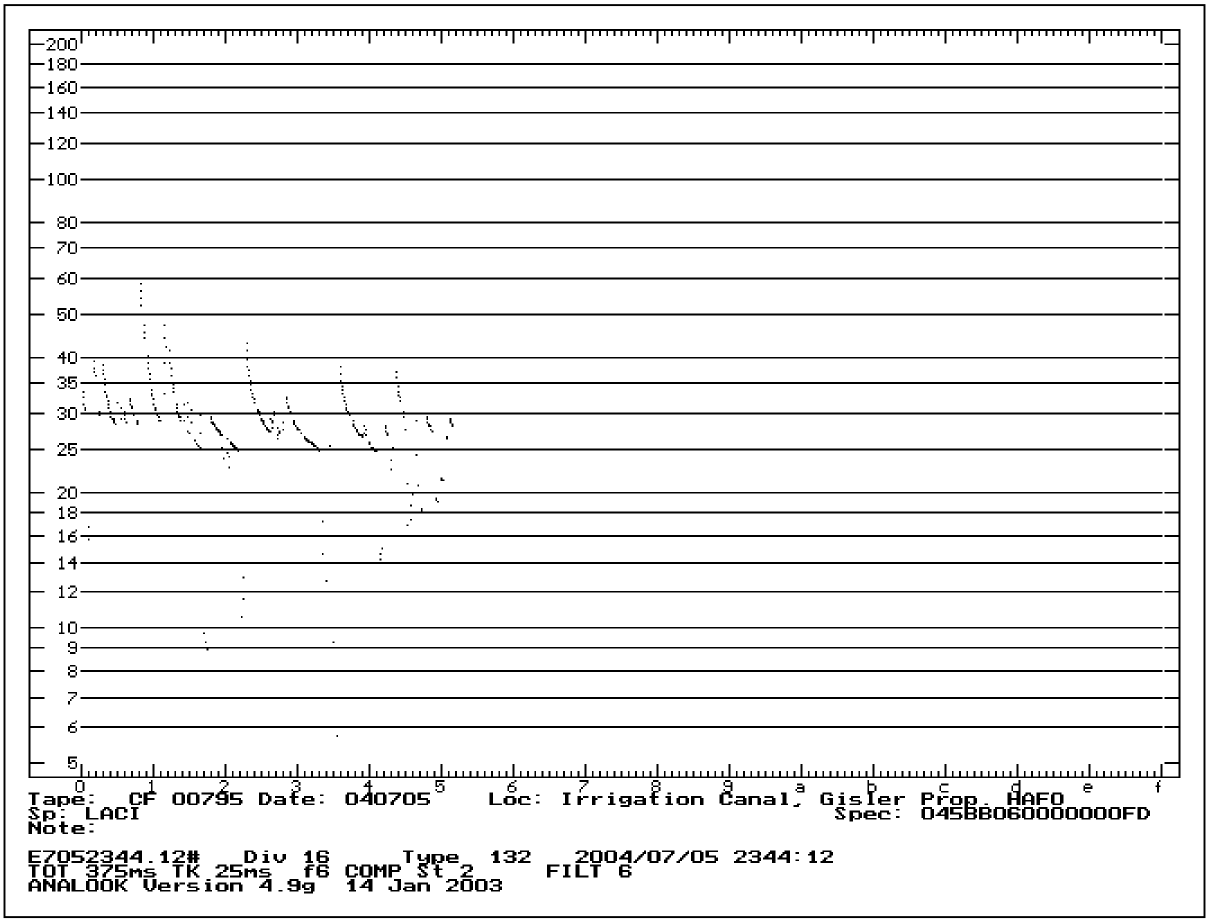

Figure A-6. A recording of a bat tentatively identified as a hoary bat recorded along the irrigation canal at the "Gisler Property", Hagerman Fossil Beds National Monument.

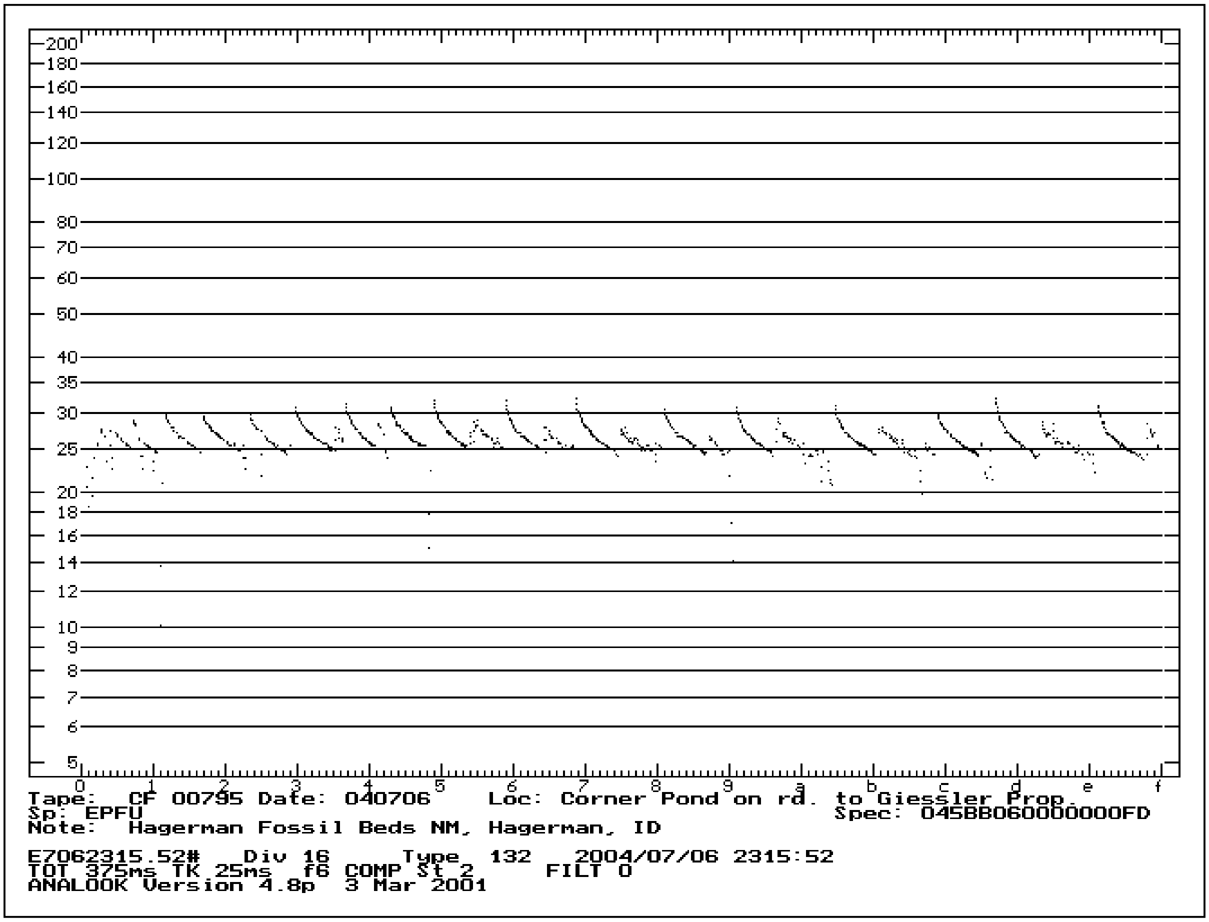

Figure A-7. A recording of a big brown bat (*Eptesicus fuscus*) recorded at a stock pond near the “Gisler Property” of the Hagerman Fossil Beds National Monument, Hagerman, Idaho.

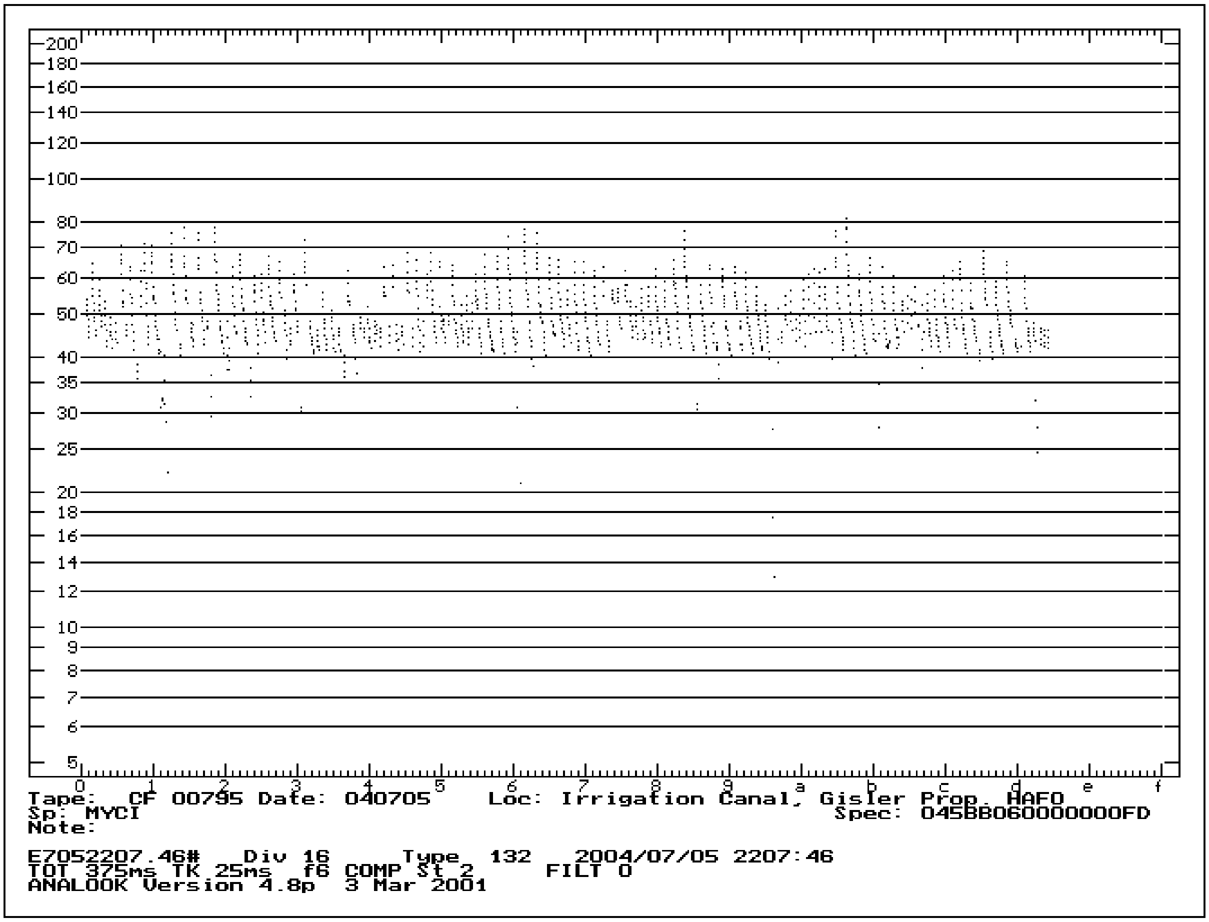

Figure A-8. A recording of a western small-footed myotis (*Myotis ciliolabrum*) recorded along the irrigation canal at the "Gisler Property", Hagerman Fossil Beds National Monument.

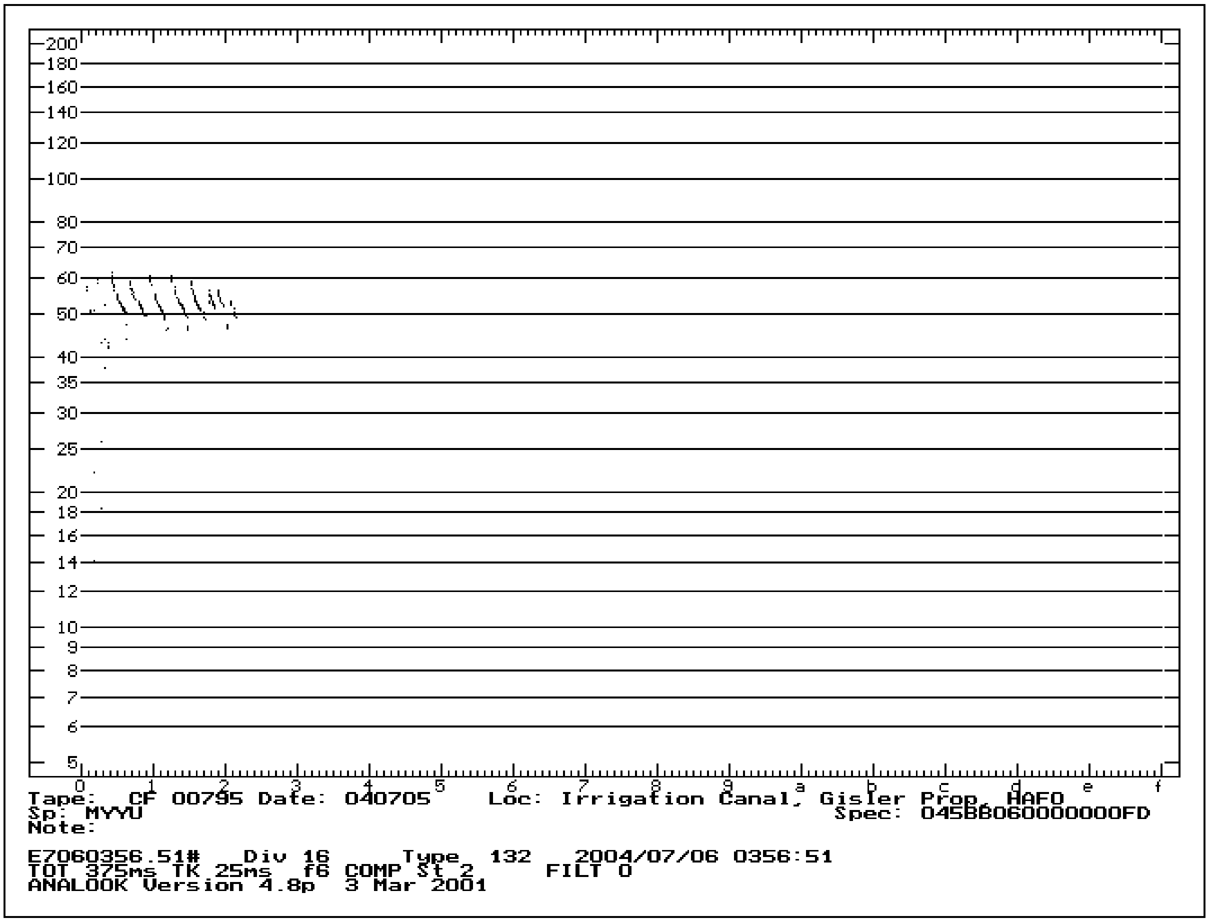

Figure A-9. A recording of a Yuma myotis (*myotis yumanensis*) recorded along the irrigation canal at the "Gisler Property", Hagerman Fossil Beds National Monument.

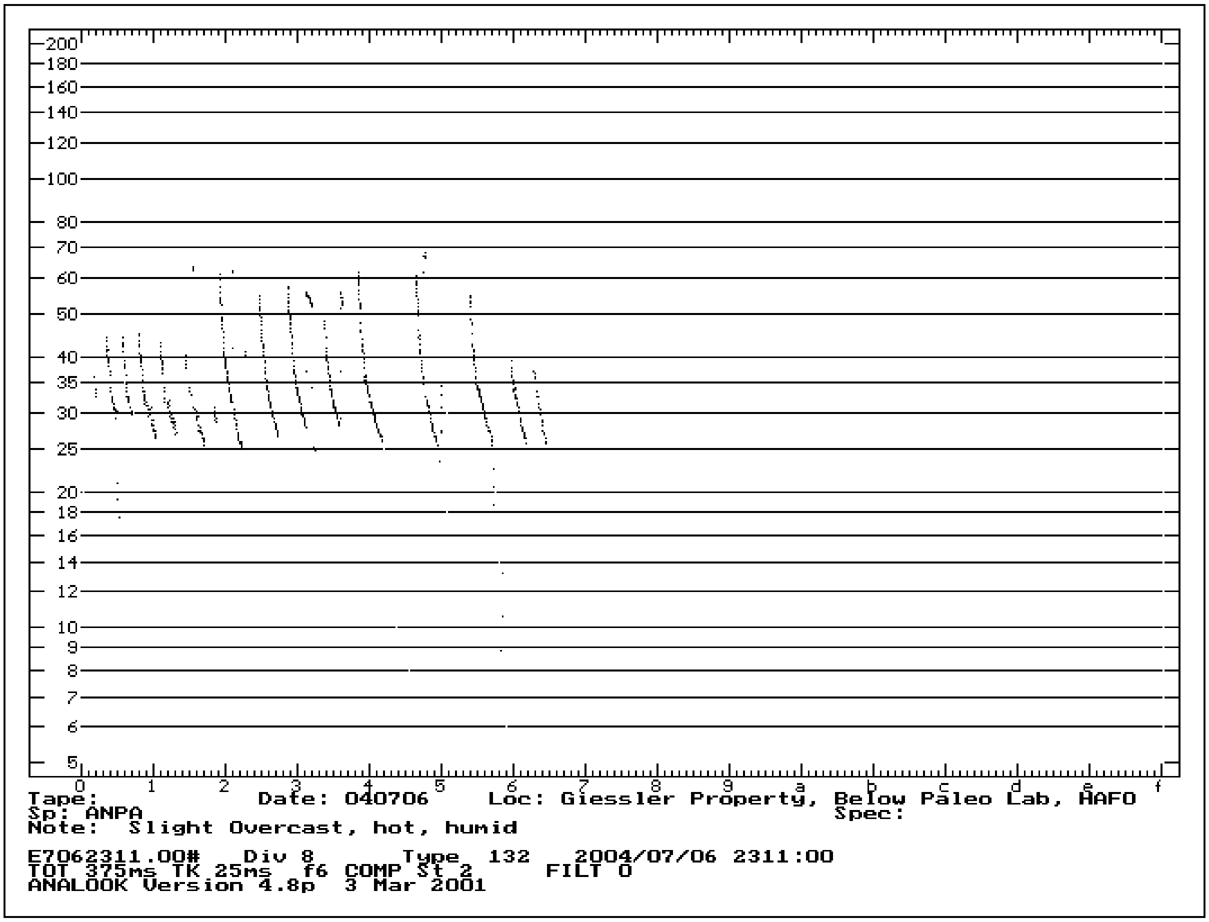

Figure A-10. A recording of a pallid bat (*Antrozous pallidus*) recorded along the irrigation canal at the "Gisler Property", Hagerman Fossil Beds National Monument.

Figure A-11. A sonobat recording of a western pipistrelle (*Pipistrellus hesperus*) recorded along the rim of Malad Gorge, Hagerman Valley, Idaho.

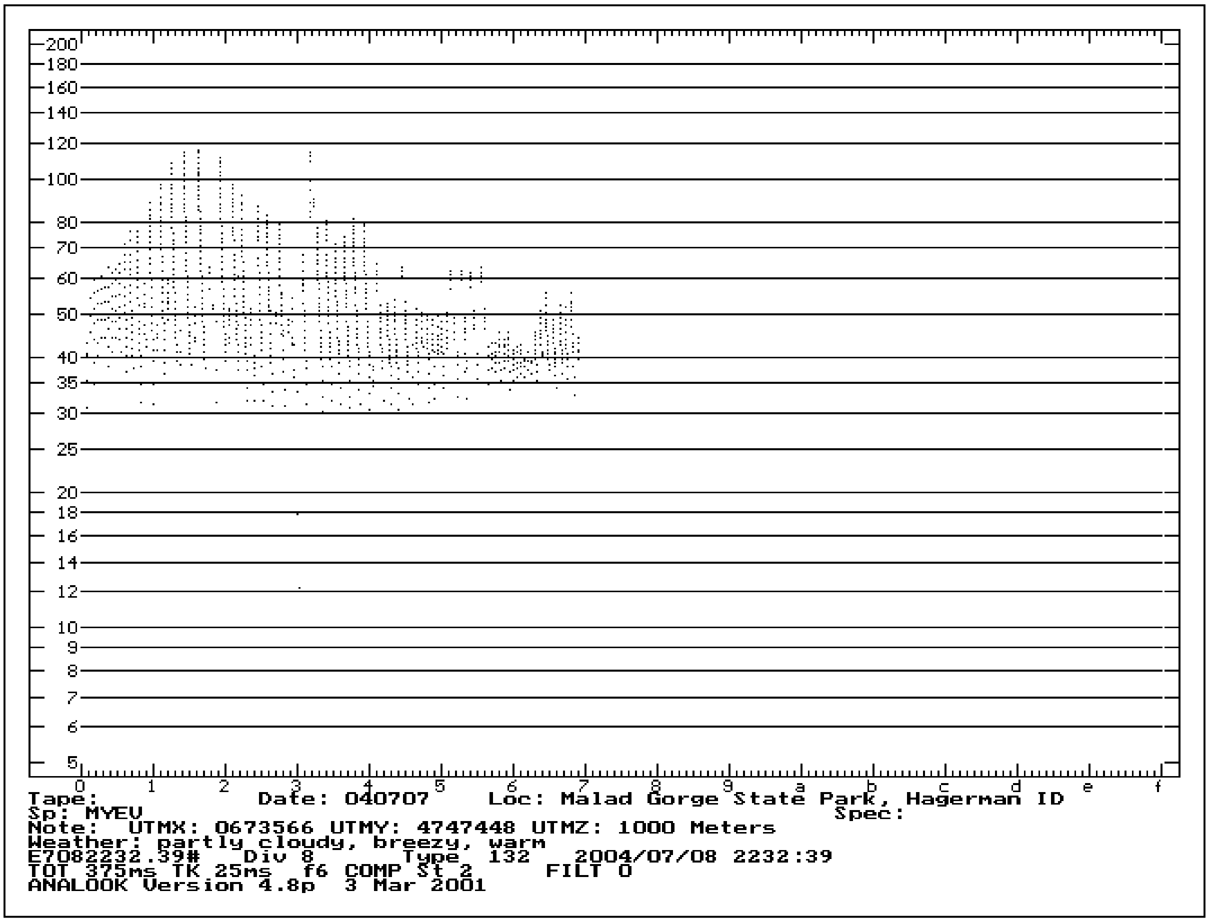

Figure A-12. A recording of a long-eared myotis (*Myotis evotis*) recorded along the rim of Malad Gorge, Hagerman, Idaho.

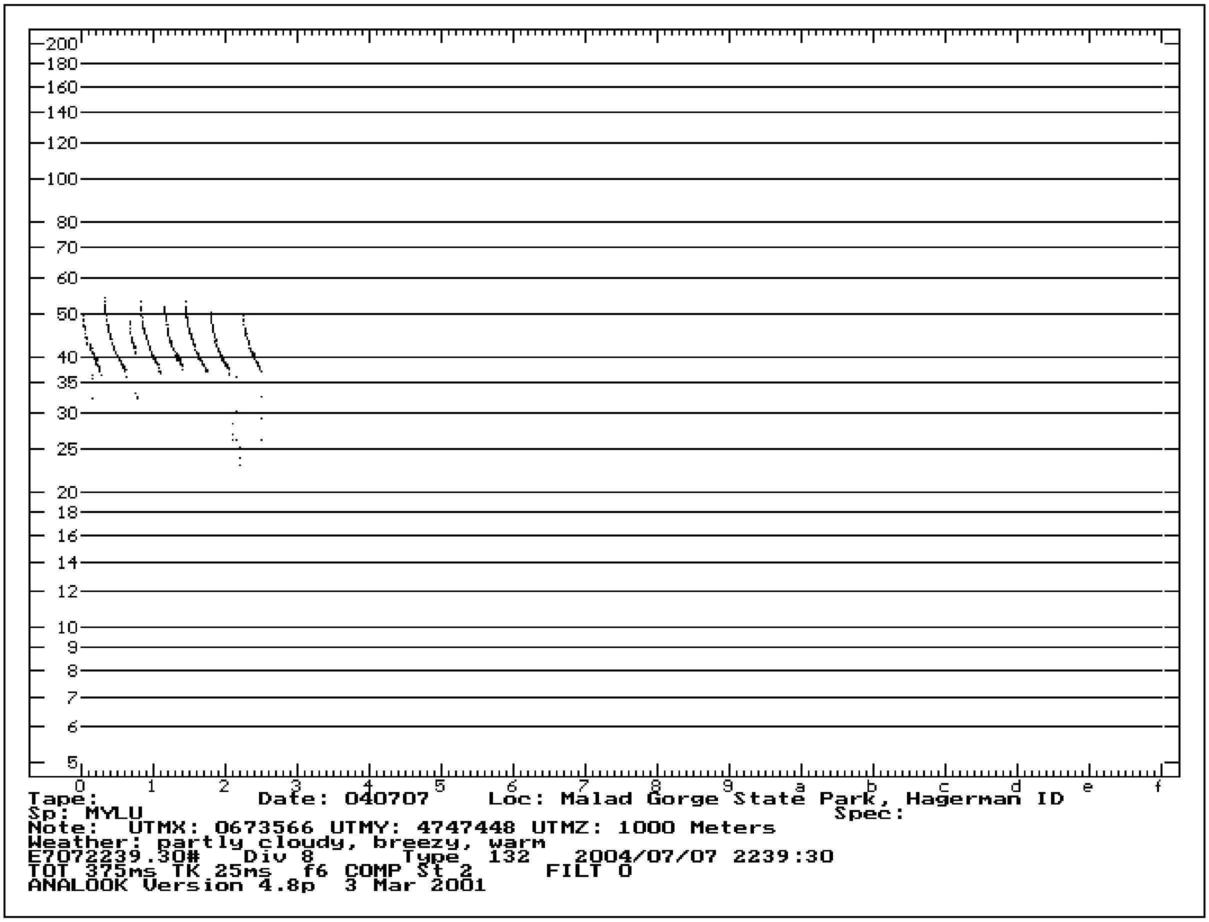

Figure A-13. A recording of a little brown myotis (*Myotis lucifugus*) recorded along the rim of Malad Gorge, Hagerman Valley, Idaho.

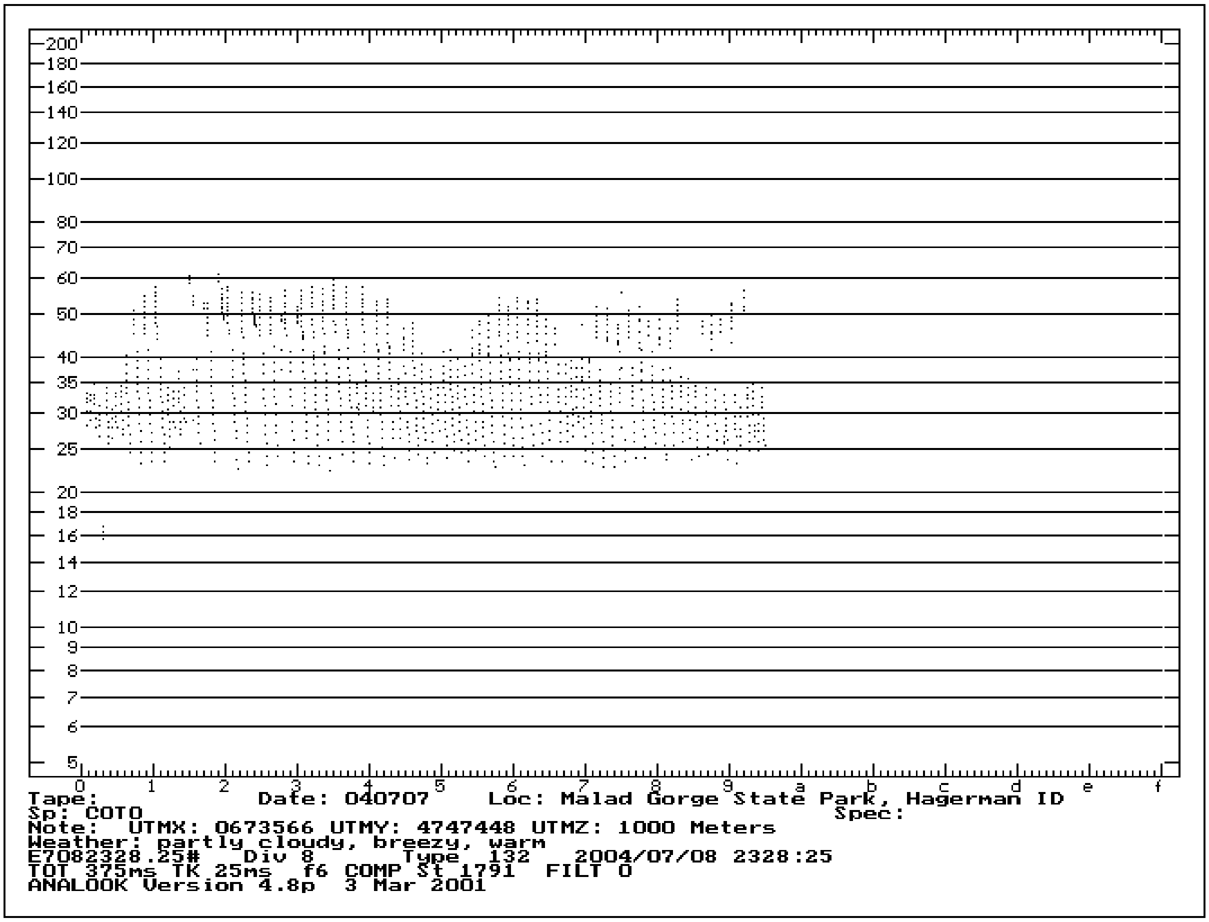

Figure A-14. A recording of a Townsend's big-eared bat (*Corynorhinus townsendii*) recorded along the rim of Malad Gorge, Hagerman Valley, Idaho.